D3

PATENT SPECIFICATION (11) 1 397 542

1 397 542

(21) Application No. 54121/74 (22) Filed 17 Feb. 1971
(62) Divided out of No. 1,397,541
(23) Complete Specification filed 17 May 1972
(44) Complete Specification published 11 June 1975
(51) INT CL² B08B 9/04
(52) Index at acceptance
F2N 1B4 X5
G1N 28X 392 614

(72) Inventors ERNEST DANIEL CASEY and LLOYD HAROLD SOLE

(19)

(54) IMPROVEMENTS RELATING TO TRAVELLERS FOR USE IN PIPELINES

(71) We, ERNEST-LLOYD LIMITED, a British Company, of Kendrick Hall, Kendrick Street, Stroud, Gloucestershire, do hereby declare this invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

When a pipeline has been constructed it is usually necessary to clean, test or gauge the line, and for this purpose it is well known to use a pipeline traveller, a so-called "pig". The pig is designed to fit closely within the pipe and is caused to travel along the pipe by admitting fluid under pressure behind the pig. Pigs are also used in operation of a pipeline to separate different fluids delivered in succession. The pigs are of various designs, the more common type being of spool shape with annular sealing members around the two flanges of the spool. Other pigs are of generally cylindrical shape, formed of resilient material such as foamed plastics, and it is also common practice to use spherical pigs, either of a solid resilient material, or inflated or inflatable.

Whatever type of pig is used there is always a risk that the pig may become jammed in the pipe and this presents serious problems particularly if the pipeline section is buried and is of great length. If the pig cannot be removed by applying pressure or other means at the end of the pig it is necessary to uncover the pipe and extract the pig, but to do so it is first necessary to locate the pig accurately. It could also be of considerable value to have means for monitoring the passage of a pig through a pipeline, so that its location at any given moment would be known with a fair degree of accuracy.

Several previous attempts have been made to provide means for locating a pig in a pipeline, but all known methods suffer from disadvantages of one type or another. If the pipeline is buried the difficulties are very considerable since acoustic testing methods cannot be applied. Methods based on the use of radioactive isotopes have obvious attendant risks and disadvantages. Attempts to locate the position of the pig by metering the quantity of pressure fluid admitted to the pipeline require expensive control equipment and highly trained operators, and tend furthermore to be inaccurate. A magnetic go-devil or traveller has also been proposed but it was not found easy to detect its magnetic field from outside the pipeline. The difficulties are further increased by the fact that the pipeline frequently traverses broken ground inaccessible to vehicles, and therefore to heavy equipment, and in other cases the line of the pipe may pass below cultivated ground which preferably should not be disturbed.

Accordingly it is an object of the invention to provide an improved apparatus for cleaning, testing gauging or operating a pipeline, especially a buried pipeline, which will at least partly overcome some of the disadvantages of previous systems.

According to the invention, a traveller for use in cleaning, testing, gauging or operating a pipeline and adapted to fit closely within it, comprises a magnetic device having magnetically permeable disc-like pole pieces situated towards the ends of the magnetic device and extending into proximity to the outer circumference of the traveller, and a non-magnetic sealing element disposed radially outwardly of the periphery of each of the pole pieces, and having an outer periphery which provides the maximum circumference of the traveller so as to form a sealing contact with and prevent the pole pieces from contacting the internal surface of the pipeline.

With a traveller according to the invention, it is possible to arrange that the

pipeline wall is magnetically saturated so that the magnetic field extends well outside the wall and can readily be detected with a sensitive magnetometer.

The magnetic device preferably comprises at least one permanent magnet. In one construction, the magnetic device comprises an externally cylindrical magnet assembly having pole pieces each of which extends from a respective end of the magnet assembly in the form of a radial flange. Each non-magnetic sealing element may comprise a resilient cup-shaped sealing element.

The invention may be carried out in various ways and several embodiments will now be described by way of example and with reference to the accompanying drawings, in which:—

Figure 1 is a sectional side elevation through a pipeline "pig" or traveller according to the invention,

Figure 2 is a cross-section on a reduced scale on the line II—II in Figure 1,

Figure 3 is a side elevation of a similar pig with brushes for cleaning the inside of a pipeline,

Figure 4 is a similar view of a "batching" pig for separating two different streams of fluid flowing along a pipeline,

Figure 5 is a similar side elevation of another form of cleaning pig having scraper blades to engage the walls of the pipeline, and

Figure 6 illustrates diagrammatically the external fields produced by such magnetic pigs travelling along buried pipelines.

The pig illustrated in Figures 1 and 2 consists basically of a pair of circular pole pieces 14, 15, rigidly secured at opposite ends of a cylindrical non-magnetic casing 20. A set of three powerful annular permanent magnets 10, 11, 12 and mounted upon a brass supporting rod 13 extending along the axis of the pig and through apertures in the pole pieces, to which the rod is attached by nuts 16, 17. The magnetically permeable pole pieces 14, 15 extend radially outwardly in the form of flanges, being rigidly located relative to one another by the structural casing 20 and the rod 13. The pole pieces are in contact with the adjacent annular magnets 10, 12 but no excessive stress is exerted on the magnets, which may be formed of a brittle material. It is important that the flux path from the ends of the magnets to the periphery of each pole piece should not be constricted since excessive flux density may reduce the total flux available at the pole pieces. Accordingly the two pole pieces are formed with bosses or rings 18, 19 which in effect provide flux guides at the re-entrant corners between the magnets and the pole flanges, and effectively increase the available cross-section of the flux path at these points. It will be noted that these flux guide bosses lie inside the non-magnetic structural casing 20. The casing 20 not only acts as a structural connection between the pole flanges but also protects the magnets 10, 11, 12 from dirt, impact or abrasion, and it will be noted that the casing is of considerably smaller diameter than the pole flanges, thus allowing the traveller to negotiate bends in the pipeline.

To the outer edge of each of the radial flange pole pieces 14, 15 is secured a resilient cup-shaped sealing element 21, 22 respectively. The sealing elements are readily removable, for replacement purposes, and are held in position by detachable end plates 23, 24 secured by bolts to the pole flanges 14, 15. Each sealing ring has a portion 25 which lies radially outside the periphery of the respective pole flange and acts as a non-magnetic spacer which prevents the pole piece making direct contact with the wall of the pipeline, in which case the magnetic attraction would become excessive. The extreme outer lip of each sealing ring is a narrow flexible skirt. The sealing rings 21, 22 are preferably formed of resilient durable plastics material such as polyurethane, and the material may include a proportion of powdered magnetic material such as ferrite, in order to improve the magnetic permeability of the gap between the pole flanges and the pipeline wall.

One of the end plates 23 has a bracket 27 with an aperture 28 for a ring by which the pig can be lifted.

The embodiment illustrated in Figure 3 is essentially similar to that of Figures 1 and 2 and like parts are indicated by the same reference numerals. In this construction a series of radially extending brush bristles 30 are provided on the casing 20 between the two pole flanges for cleaning the interior surface of the pipeline as the pig travels through it. The internal magnetic structure is identical with Figures 1 and 2.

Figure 4 illustrates another embodiment which is again basically similar to that of Figures 1 and 2, and has the same magnetic structure, but in this case the pig is intended for "batching", i.e. to move along the pipeline as a separator between two different fluids, and two extra resilient sealing cups 31, 32, are mounted at opposite ends, beyond the existing seals 21, 22.

The embodiment of Figure 5 is somewhat similar to that of Figure 3, and is designed for cleaning purposes, but the brush bristles 30 are replaced by a series of radially extending flexible plastics scraper blades 33 each disposed at a small angle to the longitudinal axis of the pig so as to cause a scraping action on the interior surface of the pipeline while also causing the pig to rotate about its

axis as it passes through the pipeline.

The pigs or travellers described above are all designed to produce a powerful magnetic field which is sufficient to saturate the wall of the pipeline. Figure 6 illustrates diagrammatically a magnetic pig of the type illustrated in Figure 1 moving along a buried pipe 80. It will be seen that the magnetic field between the pole flanges 21, 22 has saturated the pipe wall and the external magnetic field 81 extends a considerable distance from the pipe and can be detected at groung level by a sensitive magnetometer 82 which is preferably of the flux gate type, or may be a gradiometer having two spaced sensing heads for detecting a change in the field.

Magnetic pigs or travellers as described above can be used in various ways for cleaning, testing, gauging or operating pipelines. By the use of a series of detectors spaced apart at selected intervals along the pipeline, the progress of a pig through the pipeline can be followed from a remote control station. The detectors are preferably gradiometers of the flux gate type using a pair of parallel electromagnetic sensors, connected to supply a signal to the remote control station. In addition the magnetic signal produced by the traveller makes it very much easier to locate it if it becomes stuck in the pipeline.

WHAT WE CLAIM IS:—

1. A traveller for use in cleaning, testing, gauging or operating a pipeline and adapted to fit closely within it, comprising a magnetic device having magnetically permeable disc-like pole pieces situated towards the ends of the magnetic device and extending into proximity to the outer circumference of the traveller, and a non-magnetic sealing element disposed radially outwardly of the periphery of each of the pole pieces, and having an outer periphery which provides the maximum circumference of the traveller so as to form a sealing contact with and prevent the pole pieces from contacting the internal surface of the pipeline.

2. A traveller according to claim 1, wherein the magnetic device comprises at least one permanent magnet.

3. A traveller according to claim 1 or claim 2, wherein the magnetic device comprises an externally cylindrical magnet assembly having pole pieces each of which extends from a respective end of the magnet assembly in the form of a radial flange.

4. A traveller according to claim 3, wherein flux guides are disposed at the junctions between the radial flange pole pieces and the cylindrical external surface of the magnet assembly.

5. A traveller according to claim 3 or claim 4, wherein the magnet assembly comprises a plurality of annular permanent magnets disposed on an axially extending non-magnetic support rod, with adjacent faces in contact.

6. A traveller according to any one of claims 3 to 5, wherein the magnet assembly is enclosed within a non-magnetic cylindrical casing extending between the pole pieces.

7. A traveller according to any of claims 1 to 6 wherein each non-magnetic sealing element comprises a resilient cup-shaped sealing element.

8. A traveller according to claim 7, wherein each sealing element is held in position by a detachable end plate secured to the respective pole piece.

9. A traveller according to any one of the preceding claims, including radially extending brush bristles for cleaning the inside of the pipeline.

10. A traveller according to any one of the preceding claims, including radially extending scraper blades disposed at a small angle to the longitudinal axis of the traveller.

11. A pipeline traveller substantially as described with reference to Figures 1 and 2, or any of Figures 3, 4 or 5 of the accompanying drawings.

WYNNE-JONES & LAINE,
Chartered Patent Agents,
22, Rodney Road,
Cheltenham.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1975.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1397542 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

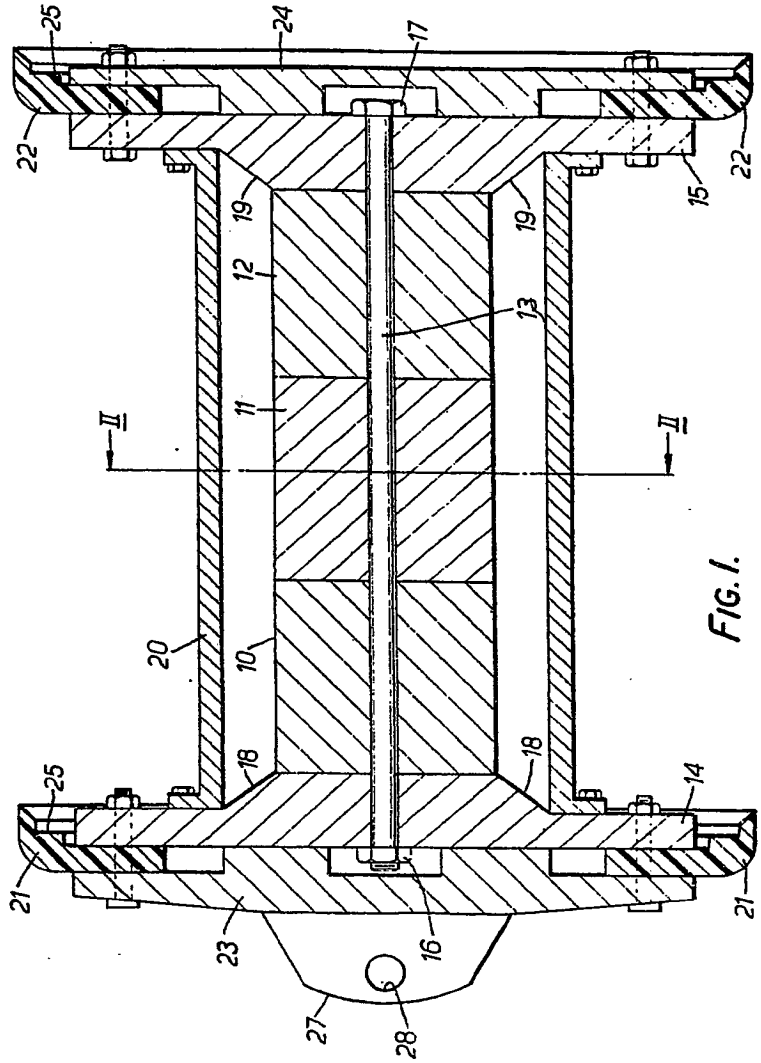

FIG. 1.

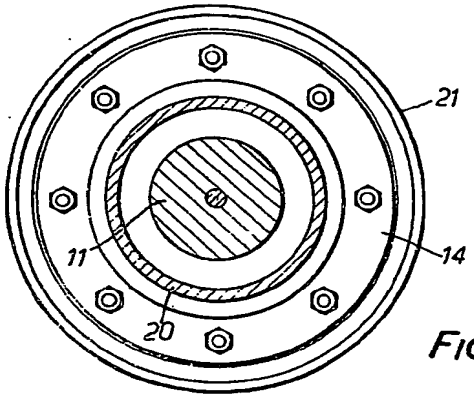

FIG. 2.

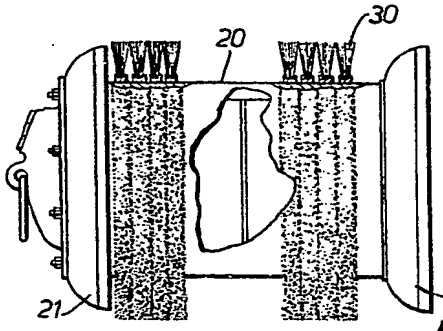

FIG. 3.

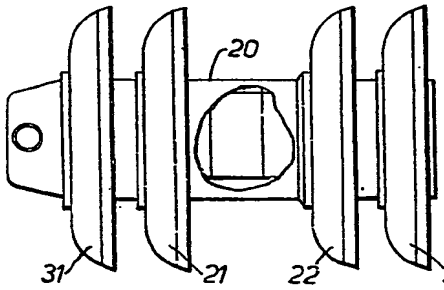

FIG. 4.

1397542 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

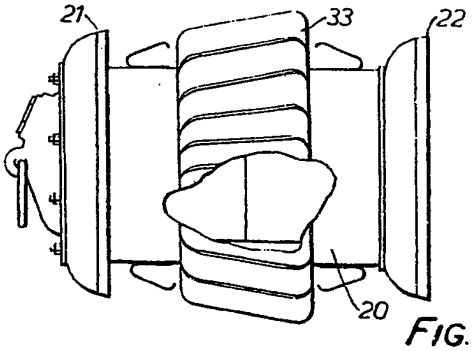

FIG. 5.

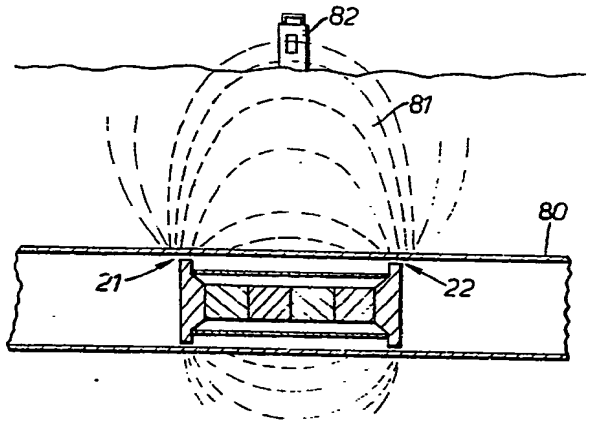

FIG. 6.